

**Impact of the Basic Materials on the Performance of EDLCs for High Power**

Hartmut Michel, Andree Schwake, Christoph J.Weber  
EPCOS AG Business Unit Ultracapacitors  
In den Seewiesen 26, D-89508 Heidenheim, Germany

The basic materials of commercially available electric double layer capacitors are activated carbon electrodes, aqueous or organic electrolytes and polymer or paper separators. The performance of the capacitors is affected by these basic materials and their mechanical design (figure 1).

The specific capacitance per volume depends on the activated carbon material of the electrodes and the interaction of the activated carbon with the electrolyte. The liquid range of the electrolyte limits the operating temperature.

There is a great impact of the basic materials on the long-term stability of the internal resistance and capacitance.

Fluctuations of the capacitance are caused by the tolerances of the carbon electrodes and therefore by the basic activated carbon material itself and the production processes of the component.

Even though deviations in the leakage current are due to small impurities of the used materials and the manufacturing process there are detectable dependence's of the leakage-current on the operating temperature.

Due to the relatively low voltage which can be applied to the individual capacitor most of the capacitors are used in modules (figure 2) where several capacitors are connected in series. Thus precautions have to be taken to avoid overcharging of some of the capacitors caused by slightly different capacitance's and different leakage-currents. This can be done by cell voltage balancing units which are especially designed for this application.

By analyzing the interaction of the different basic materials and the design parameters in double layer capacitors one was able to develop components which have a higher power density than batteries and a higher energy density in comparison to standard capacitors. Thus these devices can serve as power back up in the seconds time range in various applications like UPS systems, hybrid busses, new automotive concepts like crank shaft starter alternators and equipment for industrial automation.

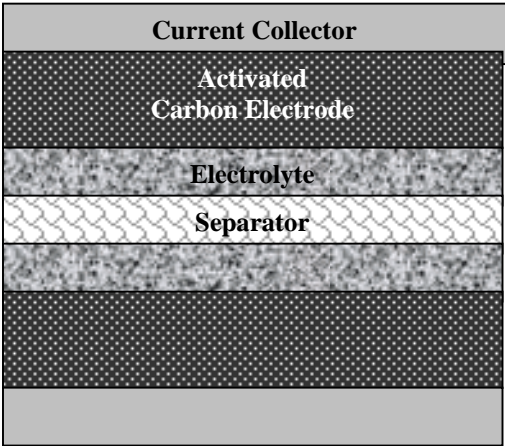


Figure 1: Basic Design of EDLC's



Figure 2: 450F/14V Module with Passive Cell Voltage Balancing